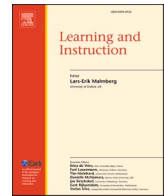




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Implicit measures of teachers' attitudes and stereotypes, and their effects on teacher practice and student outcomes: A review

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ABSTRACT

In this paper, research on implicitly measured teacher associations with social groups of students (attitudes and stereotypes) is reviewed. The aim of this review is to describe the theoretical and methodological underpinnings of the use of implicit measures in educational research, to summarize the research completed so far in which implicit measures have been used, how implicitly measured attitudes and stereotypes are related to different teacher factors and student outcomes, and to discuss challenges and directions for future research on implicit measures and their effects. A total of 49 studies was reviewed. These studies show that the use of implicit measures of teacher attitudes and stereotypes has great potential for the understanding of differential treatment of students by their teachers, but also that this line of research needs further development, with more focus on the validation of implicit measures and study designs in experimental and field settings.

1. Introduction

The purpose of this paper is to provide a review of the research on implicit teacher attitudes and stereotypes as relevant factors in the understanding of teacher behaviour and student outcomes in the context of equality of educational opportunities for all students. Teachers provide students in their classroom with opportunities to learn and, to do so, they adapt their teaching to the needs of their students (Parsons et al., 2017; Rubie-Davies, 2014). Teachers, for example, vary the time allocated to teach students, the difficulty of assignments and questions they ask students in classroom discussions, and the feedback they give to their students (Good & Brophy, 2007; Hattie & Timperley, 2007; Rubie-Davies, 2015; Rubie-Davies, 2015; Van den Bergh, Ros, & Beijjaard, 2013). Although variations in teacher behaviours have been observed in response to different student needs (Parsons et al., 2017), they may not in every case be adaptive to the needs of the students (Rubie-Davies, 2015). To be adaptive, teachers must make adequate, and therefore unbiased and unprejudiced, assessments of the needs of their students (Herppich et al., 2018). Research has shown, however, that teachers do not always form adequate assessments of students' needs (Ready & Chu, 2015; Ready & Wright, 2011; Rubie-Davies, 2015).

The basis of the provision of opportunities to learn lies in teachers' expectations and associative knowledge of their students. Research on teacher expectations has shown that teachers give students better opportunities to learn when they have high expectations of them (Rubie-Davies, 2015; Timmermans, Rubie-Davies, & Rjosk, 2018). These expectations are formed by a combination of an individual student's history (the individual student's past performance, classroom behaviour, motivations, and interests), and associations regarding social groups to which a student belongs. Prior research distinguishes two types of group associations: attitudes (i.e. prejudice) and stereotypes (Amodio & Devine, 2006; Bijlstra, Holland, Dotsch, & Wigboldus, 2019). Attitudes are often described as evaluative associations with a specific group of people (group X is positive/negative; e.g., Fazio, Jackson, Dunton, & Williams, 1995), whereas stereotypes are often referred to as qualities that are perceived to be associated with a specific group of people (group X is smart/lazy; Schneider, 2004). That expectations and group associations are at play has been confirmed by studies that showed that teachers' expectations of their students are strongly related to students' prior achievements on the one hand (Jussim & Harber, 2005), and studies that showed that teachers' estimations and predictions of students' achievement were group-biased on the other hand

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(Ready & Chu, 2015; Ready & Wright, 2011). Overestimations have, for example, been observed regarding the performance levels of positively evaluated groups, such as girls, high socioeconomic status (SES) students and students from cultural-ethnic majorities (Hughes, Gleason, & Zhang, 2005; Muntoni & Retelsdorf, 2018; Ready & Chu, 2015; Ready & Wright, 2011). Less positively evaluated groups, such as boys, low SES students, and students from cultural-ethnic minorities have been found to suffer from underestimations by their teachers (Hughes et al., 2005; Muntoni & Retelsdorf, 2018; Ready & Chu, 2015; Ready & Wright, 2011).

When teachers respond to students' needs based on biased expectations and group associations, teaching is not adaptive to the factual needs of the student, but on falsely presumed needs of students. Teachers' choice of curriculum material, the difficulty of assignments and instruction and the provided feedback may be not appropriate for these students. Teaching affected by social group associations may lead to increased achievement gaps and educational inequalities (Hornstra, Denessen, Bakker, Van Den Bergh, & Voeten, 2010; Ready & Chu, 2015; Rubie-Davies, 2015; Van den Bergh, Denessen, Hornstra, Voeten, & Holland, 2010) and can be considered a serious threat to justice and equal opportunities in education.

The mechanisms described above can be summarized in a model as presented in Fig. 1. This figure, like other models of teacher expectation effects (see for example Muntoni & Retelsdorf, 2018; Rubie-Davies, 2015), presents a relational chain between individual and group characteristics with teacher expectations, classroom experiences, and learning outcomes. It shows how learning outcomes can be explained by learning opportunities and teacher expectations, based on individual students' and their social group characteristics, where group characteristics (such as SES, migrant background, gender) are stronger at play when teachers hold stronger group associations with these social groups.

Whereas the formation and effects of teacher expectations have been studied quite extensively (Babad, 2016; Rubie-Davies, 2015; Weinstein, 2018), research on the effects of teachers' group associations in the classroom setting is less abundant. This strand of research got a boost when implicit measures of attitudes and stereotypes, that have been developed in social psychology, were applied in educational research (Hornstra et al., 2010; Van den Bergh et al., 2010). Until then, it had been quite difficult to assess teachers' group associations, mainly because the available measures were susceptible to self-presentation and social desirability.

Besides providing socially desired responses, teachers, just like the wider population, may not always be fully aware of their group associations or of the influence these associations may have on perception, judgment and behaviour, and therefore could not report them in explicit measures, such as self-reports (e.g., Gawronski & De Houwer, 2014). Although people may sometimes be aware of the content of their implicit group associations (Hahn, Judd, Hirsh, & Blair, 2014), stereotypes can also be held without the person holding them being fully aware of it (Banaji, Hardin, & Rothman, 1993). Social desirability and unawareness of associations (or its effects on subsequent processes) are two shortcomings of explicit measures of attitudes (Gawronski & De Houwer,

2014). These shortcomings may be overcome by the use of implicit (or indirect) measures of teachers' group associations, as suggested by Chang and Demyan (2007). Based on their study of explicit (or direct) measures of teachers' stereotypes of Asian, Black, and White students, they concluded that social desirability would have threatened the assessments of teachers' group associations. They suggested to use implicit measures to overcome this problem.

1.1. Implicit measures of group associations

The theoretical basis of implicit measures comes from dual process theories (Fazio, 1990; Gawronski & Creighton, 2013) and theories on implicit social cognition (Greenwald & Banaji, 1995; Nosek, Hawkins, & Frazier, 2012). According to dual process theories, human behaviour can be the outcome of two routes; it can either be the result of conscious, deliberate processing of associations and intentions or it can result from unconscious, automatic processing of associations. People might be more or less aware of the associations that drive their behaviour. Indirect, often response latency based, measures are called implicit measures, because they tap into initial responses to stimuli (Gawronski & De Houwer, 2014; Greenwald & Lai, 2020).

Implicit measures are computerized tests that ask participants to categorize or evaluate stimuli as quickly as possible, prohibiting them from deliberative processing. Examples of these measures are priming tests and implicit association tests (IATs; reviewed in Fazio & Olson, 2003). The basic idea behind implicit measures is that the measurement of attitudes and stereotypes does not involve deliberate cognitive processing of survey questions, but it requires quick spontaneous responses to verbal or visual stimuli (Greenwald & Lai, 2020; Nosek, Hawkins, & Frazier, 2011). Because of the speed of responses, the two shortcomings of explicit measures (awareness of associations and social desirability), can be overcome (or are at least less present). First, implicit measures tap into associations of which people may not be fully aware of. Even people who have the self-image that they are not biased hold group associations (Banaji et al., 1993). Second, the speed of responses and the indirect nature of the task prevents participants from providing socially desirable responses, because they don't allow time to correct for their initial response (revealing what participants are reluctant to report) or are less clear to participants in what they are aimed to measure. Whether implicit measures provide data about unconscious associations or – indirectly – about conscious attitudes is indecisive (Gawronski, 2019; Greenwald & Banaji, 2017). 'Implicit' does thus not refer to the implicitness of attitudes, but to the indirectness of the measurement (for a similar statement see Greenwald & Lai, 2020).

In a recent review, Greenwald and Lai (2020) distinguished various types of implicit measures and clustered them in three groups. *Priming* methods constitute the first group. 'Priming procedures present a stimulus in the form of a word or an image (the prime) alongside or prior to another stimulus (the target) that the subject is asked to classify, usually as pleasant versus unpleasant in valence' (Greenwald & Lai, 2020, p. 422). Response latencies of effects of primes on sorting responses are taken as implicit measures. Second, *implicit association tests* also measure

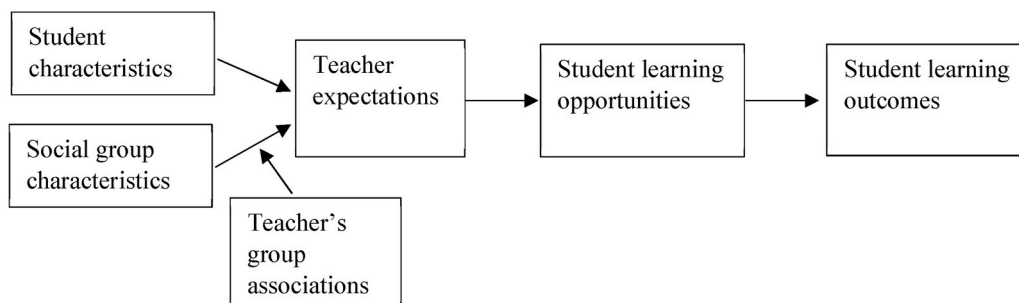


Fig. 1. A model of teacher attitudes and expectation effects on learning opportunities and learning outcomes.

response latencies of sorting stimuli in categories. IAT's usually have four categories, two group categories (e.g., male – female, White – Black) and two evaluation categories (e.g., good – bad, pleasant – unpleasant). When measuring implicit stereotypes, the evaluation criteria reflect qualities that are stereotypically related to the group categories (e.g., construction worker – teacher, mental – physical). The IAT consists of test blocks in which categories are paired with a favorable evaluation in one block and an unfavourable evaluation in the other. Algorithms have been developed to calculate bias scores from the differences in response times between two blocks (Greenwald, Nosek, & Banaji, 2003). The third group consists of other, less used measures, such as approach-avoidance tasks or mouse tracker techniques (see Greenwald & Lai, 2020, for details regarding these measures).

For decades, implicit measures have been frequently used in many disciplines (for reviews see for example Dehon et al., 2017; De Fitz-Gerald & Hurst, 2017). Recently, a meta-analysis demonstrated that implicit and explicit measures both have their unique relation with behaviour (Kurdi et al., 2019). However, implicit measures are not free of debate among scholars. For example, the test-retest reliability (e.g., Rae & Olson, 2018) and predictive validity (e.g., Bosson, Swann, & Pennebaker, 2000; Oswald, Mitchell, Blanton, Jaccard, & Tetlock, 2013) of the IAT seem to be mixed. In sum, although a recent meta-analysis has shown that implicit/explicit measures predict behavioural outcomes, the relation between implicit processes and behaviour is sometimes complicated. This relation is, for example, not unconditional and strongly affected by the context (for an overview, see Gawronski, 2019).

1.2. Implicit measures of teacher attitudes

In 2010, the first study that used implicit measures of teacher attitudes was published (Van den Bergh et al., 2010). It was a study on the relations between primary school teachers' attitudes towards ethnic minority students (i.e., from Turkish and Moroccan backgrounds), teachers' expectations of their own students and students' academic achievement. An explicit self-report measure and an IAT were used to measure teachers' attitudes. The study revealed that teachers' implicitly measured attitudes were related to differential expectations of ethnic minority students and non-minority students and as well to the ethnic achievement gaps between both groups of students. In classrooms of more biased teachers, expectations and achievement gaps between students from Turkish and Moroccan backgrounds on the one hand and non-migrant students on the other were larger than in classrooms of less biased teachers.

Since 2010, implicit measures of teacher attitudes have been applied in multiple educational studies. A recent meta-analysis of teachers' group associations regarding students from different social groups (Pit-ten Cate & Glock, 2019) included 22 studies. These studies focused on teacher attitudes toward a variety of student characteristics, including ethnicity, gender, obesity, special educational needs, and SES. The results of the meta-analysis indicated that teachers' implicit attitudes are on average in favor of non-marginalized groups. In addition, a comparison with explicit measures was made, indicating non-significant or low correlations between implicit and explicit measures of teacher attitudes. Although this meta-analysis has provided much insight in implicit measures of teacher attitudes in educational studies, this case is far from complete. For example, in their meta-analysis, Pit-ten Cate and Glock did not focus on how implicit measures of teacher attitudes are associated with teacher expectations of individual students, teaching practices, or student outcomes. An important next step is to review the literature how this may impact teachers' behaviours and student outcomes. With this review we focus on the teacher and student variables that are related to teachers' attitudes and stereotypes. With this review, we also aim to present a broad overview of the variety of research on implicit teacher attitudes so far. We will reflect on the state of the art of the research of implicit measures of teacher associations and present some directions for future research in this field.

This review is aimed at empirical outcomes of studies that have used implicit measures of teacher associations since 2010, addressing the following questions:

1. Which teacher-related factors are associated with implicitly measured teacher attitudes?
2. Which student-related outcomes are associated with implicitly measured teacher attitudes?

The predictive value of implicit measures of teacher attitudes on student-related outcomes was examined, by comparing the effects of implicit and explicit attitude measures.

2. Method

The literature search was conducted in September 2020, using the databases PsycInfo, Eric, and Scopus. The search was limited to articles published after 2010. In our search we used the following keywords for the title, abstract, or keywords: (teacher* or instructor*) and implicit and (attitude* or belief* or prejudice* or bias* or association*). This search yielded 401 unique references, including six references which were obtained through the snowball method, i.e., by screening the references list of previous studies. Thereafter, the abstracts, and in some cases the full-text articles, were screened for eligibility and we selected studies that (1) included an implicit attitude measure; (2) included preservice or in-service teachers as participants; (3) focused on implicitly measured attitudes toward specific target groups of students; (4) described an empirical study; (5) were published in a peer-reviewed journal; and (6) were written in English. During screening, we checked whether articles met the inclusion criteria in the order they are listed. That is, articles were excluded if they did not meet the first criterion without further screening for the subsequent criteria. If they met the first criterion, we checked if they met the second criterion, and so on. Hence, most article were excluded because they did not meet the first criterion (see the Prisma diagram in Fig. 2). We also included paper-and-pencil versions of the IAT as these are time-based. Articles that used other indirect types of attitude measures which were not based on response latencies, such as card-sorting tasks, the Affect Misattribution Procedure (AMP), or thermometers, were excluded from this review, as these measures may be more prone to participants purposely controlling their responses compared to measures based on response latencies. Studies which included educational professionals or students in an education-related field who were working with or were being trained to work with students in an educational setting were also included (e.g., students majoring in special education; tutors employed in schools for special education). In the end, the number of studies to be included was 49 studies.

2.1. Coding and analyses

To systematically analyze the findings of the studies included in the review, the following study features were coded: information about the type of implicit measure(s) used in the study; information about the participants and if applicable also their students; and the design and context of the study. To answer the research questions we coded (1) the associations between teacher-related factors and teachers' implicitly measured attitudes; and (2) associations between teachers' implicitly measured attitudes and student-related outcomes. As our review is descriptive in nature, we mostly used 'code-and-count' analyses to answer our research questions. For the first research question, we analyzed which teacher-related factors were included in the studies and if and how these were related to implicitly measured attitudes. To address the second research question, we examined which student-level outcomes were included in the studies and whether and how these were predicted by implicitly and explicitly measured group associations. Before answering the research questions, we will first describe the types

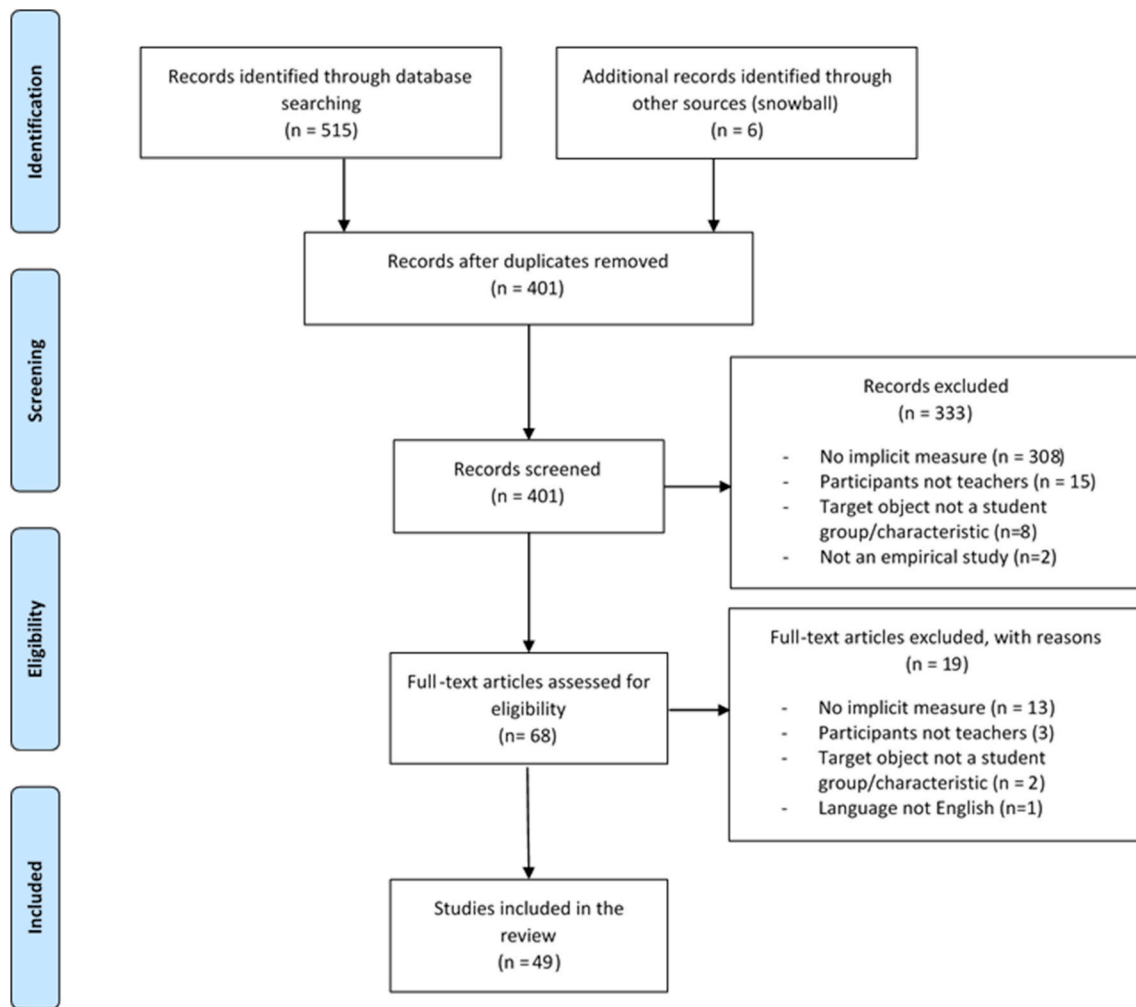


Fig. 2. Prisma diagram of the literature search.

of implicit measures used and the target and evaluative categories that were used in these measures.

3. Results

3.1. Types of implicit measures

Table 1 shows the used implicit measures of teacher's group associations of the 49 included studies. Most studies (44 studies, 89.8%) have used implicit association tests in different variations, such as a brief-IAT (B-IAT), a single target IAT (ST-IAT), a paper-and-pencil IAT (PP-IAT), an Implicit Relational Assessment Procedure (IRAP) and a sorting paired features tasks (SPF). In contrast to a regular IAT that evaluates two social categories, a single target IAT (ST-IAT) evaluates a single category. Lautenbach and Antoniewicz (2018) developed a ST-IAT in which pleasant and unpleasant evaluations were paired with 'inclusion' as a single target. A paper-and-pencil IAT is a non-computerized version of the IAT. Participants are asked to categorize as many as possible words within a fixed time frame. Russell-Mayhew et al. (2015), for example, asked participants to categorize as much positive and negative pairings with fat and thin people as possible within 20 s to assess anti-fat attitudes of preservice teachers. The IRAP includes labels (e.g., 'autism spectrum disorders' and attribute words (e.g., 'good' or 'bad') which participants are asked to categorize as being similar or opposite (see Kelly & Barnes-Holmes, 2013). Finally, a SPF is an IAT in which attitude targets and evaluations are presented in pairs in the four corners of a screen. Participants are asked to sort stimuli (that

include a category and an evaluation) with one of four response keys. Nürnberger, Nerb, Schmitz, Keller, and Sütterlin (2016) have developed such an SPF to study teachers' gender stereotypes, with boys and girls as categories and math/science and language as evaluation categories.

Table 1 also shows that seven studies (14.3%) (also) used priming measures. Priming tasks ask participants to judge a target word that has a general evaluative meaning (e.g., pleasant, horrible) as positive or negative after having been presented with the prime very briefly, for example a neutral string of letters or the prime word 'dyslexia' (see Hornstra et al., 2010).

3.2. Target of implicit measures

The target of the implicit measures included various social categories to which students belong. Almost half of the studies were aimed at students from different racial or cultural-ethnic backgrounds (23 studies, 46.9%). These studies mainly targeted majority versus minority students, with target groups that were specific for the context of the study. U.S.-studies targeted Black and White students (Axt, 2017; Quinn, 2020; Halberstadt et al., 2020; Whitford & Emerson, 2019), African-American, Caucasian, Arab-American and Chaldean students (Conaway & Bethune, 2015; Kumar, Karabenick, & Burgoon, 2015), or English learners and mainstream students (Harrison & Lakin, 2018a, 2018b). Studies conducted in Europe targeted Southern-European, Chinese, Turkish, or Moroccan students, or students from immigrant backgrounds versus German, Italian, or Dutch students, or students from non-immigrant backgrounds (Bonefeld & Dickhäuser, 2018; Calamai &

Table 1*Study characteristics and associations between implicitly measured teacher attitudes and teacher-related factors.*

First author	Year	Type of implicit measure	Target	Evaluation	Teacher Sample	Teacher factors	Findings regarding relations between teacher factors and implicit measures
Axt	2017	B-IAT	Race/ Ethnicity	Good-bad	618 other	EA	Implicitly and explicitly measured attitudes positively correlated
Bonefeld	2018	IAT	Race/ Ethnicity	Good-bad performance	203 preservice	–	–
Calamai	2020	IAT with audio	Race/ Ethnicity	Good-bad	78 inservice	EA; WC	Implicitly measured attitudes of teachers from two different schools with different populations did not differ.
Carmona-Marquez	2020	IAT	Physical appearance	Good-bad; motivated-lazy	156 inservice	EB	Implicitly and explicitly measured attitudes not significantly correlated.
Conaway	2015	B-IAT	Race/ Ethnicity	Positive-negative	119 inservice	EA	Physical education (PE) and mathematics teachers showed similar biases, except for the automatic obesity–laziness association, which was stronger for PE teachers than for mathematics teachers.
De Kraker Pauw	2016	IAT	Gender	Career in STEM - arts Abilities in STEM -arts Guided-independent learning	107 inservice	D; EB	No significant relation between the three implicit measures and corresponding explicit measures.
Fontana	2013	PP-IAT	Physical appearance	Good-bad; motivated-lazy	47 inservice; 147 preservice	D; EB; WC	Male teachers held stronger girls-guided learning and boys-independent learning associations than female teachers.
Fontana	2017	IAT	Physical appearance	Good-bad; Motivated-lazy	94 inservice	EA	Teaching in a STEM domain was associated with stronger gender-beliefs for male teachers.
Glock	2018	IAT	Race/ Ethnicity	Positive-negative Like-dislike	108 inservice; 90 preservice	EA; SE	Teacher gender, academic year, teaching experience, and school type (elementary/secondary) not significant.
Glock	2015	IAT; priming	Race/ Ethnicity	Positive-negative	65 preservice	–	1 out of 4 correlations significant: implicitly and explicitly measured attitudes (weakly) positively correlated.
Glock	2017	IAT	Race/ Ethnicity	Positive-negative	164 inservice	SE; WC	1 out of 6 correlations significant: Negative implicitly measured attitudes associated with less enthusiasm for teaching multicultural classes.
Glock	2017	IAT	Gender	Positive-negative behavior	98 preservice	–	Overall difference between elementary and secondary school teachers not significant, interaction school type and gender significant.
Glock	2019	IAT	Race/ Ethnicity	Positive-negative	216 preservice	D; SE; EA	–
Glock	2013	Priming	Race/ Ethnicity	Positive-negative	40 preservice	–	Minority teachers had more positive implicitly measured attitudes than majority teachers.
Glock	2016	Priming	Physical appearance	Positive-negative	51 preservice	EA	No significant relations with self-efficacy.
Glock	2019	IAT	Race/ Ethnicity	Positive-negative	105 preservice; 231 inservice	WC; SE; EA	Mixed findings for explicit measures.
Halberstadt	2020	IAT	Race/ Ethnicity	Good-bad	178 preservice	EA	–
Harrison	2018	IAT	Race/ Ethnicity	Good-bad	197 inservice	EA	No significant relations with six explicit measures, including motivation to respond without prejudice.
Harrison	2018	IAT	Race/ Ethnicity	Good-bad	116 preservice	EA	Mixed findings regarding cultural diversity of the school.
Hein	2011	IAT	SEN	Pleasant-unpleasant	47 other	C	Positive implicit attitudes were associated with stronger efficacy for teaching minority students in Study 1, but not Study 2.
Hornstra Kelly	2010	Priming	SEN	Positive-negative	30 inservice	EA	1 out of 5 correlations with explicit measures significant: less prejudiced explicit attitudes associated with more positive implicit attitudes (but only in schools with low diversity, not high diversity)
Kelly	2013	IRAP	SEN	Positive-negative	16 other; 16 inservice	EA	Implicitly and explicitly measured attitudes were significantly, positively correlated
Kelly	2015	IRAP	SEN	Good-bad behavior	30 inservice	EB EA	Implicitly and explicitly measured attitudes were not significantly correlated
							1 of 3 correlations significant: implicit measure and attitude toward second language learners negatively correlated.
							Amount of contact and quality of contact not predictive of implicitly measured attitudes
							No significant relations with explicit measure.
							Mixed findings: For specialized tutors a negative relation between the implicit and explicit (likert) measure was found, for regular teachers, relations were non-significant.
							Specialized tutors showed effects that were antipunishment and proreinforcement for both good and bad behavior, whereas the regular teachers showed effects that were propunishment for bad behavior and proreinforcement for good behavior.

(continued on next page)

Table 1 (continued)

First author	Year	Type of implicit measure	Target	Evaluation	Teacher Sample	Teacher factors	Findings regarding relations between teacher factors and implicit measures
Kleen	2018	IAT	Race/Ethnicity	Positive-negative	160 inservice	D	71 of 76 correlations with explicit measures not-significant. Teacher gender not significant. Teachers with minority backgrounds had more positive implicitly measured attitudes toward minority students.
Kleen	2019	IAT	Race/Ethnicity	Positive-negative	149 preservice	D	Turkish preservice teachers' implicit attitudes were more in favor of Turkish students than German preservice teachers' attitudes.
Krischler	2019	Priming	SEN	Positive-negative	46 preservice; 35 inservice	EB	No significant difference between pre- and inservice teachers.
Kumar	2014	IAT	Race/Ethnicity	Positive-negative	241 inservice	WC; EA; TA	No significant relation with school ethnic composition. No significant relation with explicit measure. 1 out of 5 correlations with self-reported teaching approaches significant: Implicit negative attitude toward Arab/Chaldean American students was associated with less promotion of respect in the classroom.
Lau	2018	PP-IAT	Physical appearance	Good-bad; motivated-lazy	100 preservice; 100 inservice	D; EB	Teacher gender not significant. Younger teachers showed more bias against overweight children. Specialized PE teachers exhibited a stronger bias against overweight children on 1 of 2 IATs.
Lautenbach	2018	ST-IAT	SEN	Pleasant-unpleasant	62 preservice	EB; EA; TA	No significant difference between first and third semester students. Implicitly and explicitly measured attitudes towards inclusion are negatively correlated. Reported readiness to teach inclusively did not correlate with implicit attitudes.
Luke	2018	ST-IAT	SEN	Positive-negative	163 preservice	D	Male teacher students and those without children held more positive implicitly measured attitudes toward inclusion.
Lynagh	2015	IAT	Physical appearance	Good-bad; smart-stupid	239 preservice	EB; EA;	Preservice teachers specialized in health en physical education held a stronger implicit anti-fat bias compared to non-specialized teachers. BMI, Age, and gender not significantly related to implicit antifat bias. The two implicit measures were significantly positively correlated. 1 out of 14 correlations with explicitly measured attitudes was significant: A stronger anti-fat bias on the smart-stupid IAT was associated with lower expectations of overweight children's cooperation skills.
Markova	2015	Priming	Race/Ethnicity and SEN	Positive-negative	46 preservice	EB; C; EA	No significant relation with teaching experience. No significant effect of having friends or family with SEN.
Nurnberger	2015	IAT (SPFT)	Gender	Math-science	122 preservice	D; EA	No significant relations with 3 explicit measures, including motivation to act without prejudice. Teacher gender not significant.
Peterson	2016	IAT	Race/Ethnicity	Success-failure	38 inservice	WC	No significant relation with explicit gender stereotypes or deterministic beliefs
Pit-ten Cate	2018	IAT	SES	Positive-negative	70 inservice	D; WC; EA	Teacher attitudes were more in favor of European students, when the school SES was higher.
Preckel	2015	ST-IAT; priming	Gifted	Intellectual abilities; Adjustment difficulties; Positive-negative	182 preservice	–	No significant relation with age, experience, or school type
Quinn	2020	IAT	Race/Ethnicity	Competent-incompetent	1549 inservice	–	No significant relations with 3 explicit measures.
Readdy	2016	PP-IAT	Physical appearance	Motivated-lazy	18 preservice	EA	–
Russel-Mayhew	2015	PP-IAT	Physical appearance	Positive-negative	30 preservice	I	The professional development workshop reduced implicit weight bias.
Scanlon	2013	IRAP	SEN	Positive-negative	25 inservice; 20 preservice	I	Both a behavioral intervention and Stress Reduction Intervention appeared to enhance positivity enhance implicitly measured attitudes toward pupils with emotional or behavioral disabilities. -
Scanlon	2020	IRAP	SEN	Positive-negative	40 inservice; 20 preservice; 20-non teachers	EB	Teachers showed a bias toward pupils with emotional behavioral disorders, while the control group of non-teachers did not, but the difference between both groupes was not statistically significant (Study 1).

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Table 1 (continued)

First author	Year	Type of implicit measure	Target	Evaluation	Teacher Sample	Teacher factors	Findings regarding relations between teacher factors and implicit measures
Starck	2020	IAT	Race/ Ethnicity	Good-bad	68,930 inservice; 1.6 mln non-teachers; 63 inservice; 1921 non-teachers	EB	Primary school teachers did not differ from post-primary school teachers in their implicitly measured attitudes (Study 2). Both teachers and non-teachers held pro-White explicit and implicit racial biases. Differences between teachers and nonteachers were small (Study 1) or insignificant (Study 2).
Thijs	2018	IAT	Religion	Positive-negative	35 inservice	D	Muslim teachers held more positive implicit attitudes toward Muslim students than non-Muslim teachers.
Thomas	2017	IAT	Gender	Science-humanities	88 inservice	D	Teacher gender and age not significant.
Van den Bergh	2010	IAT	Race/ Ethnicity	Positive-negative	41 inservice	EA	No significant relation with explicit measure.
Vezzali	2012	IAT	Race/ Ethnicity	Positive-negative	5 inservice	EA	No significant relation with explicit measure.
Wilson	2019	ST-IAT	SEN	Positive-negative	87 inservice	D; EB; SE; EA; TA	No significant relations with teaching experience, completion of special education training, teaching self-efficacy, explicit measures, or self-reported teaching behavior.
Whitford	2019	IAT	Race/ Ethnicity	Positive-negative	34 preservice	I	A brief empathy soliciting intervention had a statistically significant effect on reducing Negative implicit bias toward Black individuals
Wutrich	2018	ST-IAT	SEN	Positive-negative	114 preservice	EB; EA	Specialized preservice teachers had more favorable implicit attitudes toward inclusion. No significant relation with explicit measure.

Notes. Target: SEN = Special Educational Needs. Sample: Other = Other educational professionals/students. Teacher factors: D = Demographics; EB = Educational Background; WC = Work Context factors; C = Contact with group members; I = Intervention; SE = Self-Efficacy for teaching; EA = Explicit Attitudes and beliefs; TA = Teaching Approaches (self-reported) & behavioral measures.

Ardolino, 2020; Glock & Böhmer, 2018; Glock & Karbach, 2015; Glock & Klapproth, 2017; Glock & Kleen, 2019; Glock, Kneer, & Kovacs, 2013; Glock, Kovacs, & Pit-ten Cate, 2019; Kleen, Bonefeld, Glock, & Dickhäuser, 2019; Kleen & Glock, 2018; Markova, Pit-Ten Cate, Krolak-Schwerdt, & Glock, 2016; Van den Bergh et al., 2010; Vezzali, Giovannini, & Capozza, 2012). A New-Zealand study by Peterson, Rubie-Davies, Osborne, and Sibley (2016), the only study not conducted in the U.S. or Europe, targeted Asian, Maori and European students.

Other categories were students with special educational needs (11 studies, 22.4%), students' physical appearance (8 studies, 16.3%, all focusing on overweight students), and boys and girls (4 studies, 8.2%). Single studies focused on gifted students (Preckel, Baudson, Krolak-Schwerdt, & Glock, 2015), low-SES versus high-SES children (i.e., the educational level of the parents, Pit-ten Cate & Glock, 2018), good and bad behaving students (Kelly & Barnes-Holmes, 2015), or Muslim versus non-Muslim students (Thijs, Hornstra, & Charki, 2018).

Stimuli representing the target categories were pictures, names, words related to the categories, or labels. For example, Bonefeld and Dickhäuser (2018) used pictures of male and female individuals with a migrant (i.e. Turkish) and without a migrant background (i.e., German). Glock and Klapproth (2017) selected names commonly given to German children (e.g., Lukas, Jonas, Leonie, Hannah) and Turkish names (e.g., Cem, Gökhan, Elif, Tugba) as stimuli for children with and without a migrant background. Lautenbach and Antoniewicz (2018) used words like 'together' 'integration', and 'quality' as stimuli to measure attitudes towards inclusion in a single target-IAT. Calamai and Ardolino (2020) used an IAT with auditory stimuli (with words spoken in standard English or English with a Chinese accent) to assess implicit attitudes toward native-Chinese students. An example of using labels is the study by Hornstra et al. (2010). They presented the word 'dyslexia' as a prime in their priming study.

3.3. Evaluations of social categories

A large majority of studies (40 studies, 81.6%) measured attitudes using general evaluations in terms of positive and negative words or

words like 'bad' and 'good' to be associated with social categories. Other types of evaluations referred to stereotypes, such as bad versus good behaviour (5 studies, 12.2%), high and low academic achievements (4 studies, 9.8%), lazy or motivated (5 studies, 10.2%) or positive versus negative stereotypes about students (for example towards STEM-subjects; 3 studies, 7.3%). Studies thus did not only tap into biased attitudes towards social groups, but also into specific education-related stereotypes. Peterson et al. (2016), for example, used pictures of good and poor student grades to study the performance-related stereotypes of teachers towards students from different cultural ethnic backgrounds. Lau, Leung, Pitkethly, and Ransdell (2018) developed an IAT to measure stereotypes of physical education teachers towards 'fat' and 'thin' students as to whether they are 'lazy' or 'motivated' and Kelly and Barnes-Holmes (2015) used words like 'working', 'studying', 'compliance', and 'reading' on the one hand and 'kicking', 'spitting', 'screaming', and 'shouting' on the other to evaluate good and bad student behaviours, respectively.

3.4. Associations between teacher-related factors and implicitly measured teacher attitudes

Most studies (81.6%), with the exception of six studies (Bonefeld & Dickhäuser, 2018; Glock et al., 2013, 2017; Glock & Karbach, 2015; Preckel et al., 2015; Quinn, 2020) included one or several teacher-related variables and reported relations between implicitly measured teacher attitudes and these teacher-related factors. These teacher related-factors entailed a broad range of factors and included (1) factors that were considered to be predictive of implicitly measured teacher attitudes, such as teacher demographics, teachers' educational background characteristics, work context factors (i.e., factors related to the schools teachers were working at), or the amount or quality of contact between the teacher and group members of the groups at which the implicit measures were targeted; (2) factors that were considered to be correlated, but not causally related, to implicitly measured teacher attitudes, such as explicitly measured teacher attitudes; (3) factors that were described as being predicted by implicitly measured teacher

attitudes, including self-reported teaching approaches, self-efficacy for teaching, and behavioral outcomes; and (4) interventions aimed at reducing implicit bias. Table 1 summarizes the findings with regard to these relations and the findings are described below.

3.4.1. Teacher-related factors predictive of implicitly measured teacher attitudes

Implicitly measured teacher attitudes were related to demographic teacher characteristics, such as teachers' gender, age, or ethnic background in 13 studies (26.5%). Overall the findings suggest that implicitly measured teacher attitudes do not significantly differ by demographic background characteristics, unless it involves group membership of the group at which the implicit measure is targeted. That is, Glock and Kleen (2019), Kleen and Glock (2018), and Kleen et al. (2019) found that teachers' implicitly measured attitudes toward ethnic minority students were more positive when teachers themselves had a minority background. Similarly, Thijs et al. (2018), who conducted their study among teachers working at Islamic schools, found that Muslim teachers' implicitly measured attitudes toward Muslim students were more positive than those of their non-Muslim colleagues. Gender was the most frequently examined teacher factor and was included in nine studies. In most studies, gender was not associated with implicitly measured attitudes, with the exception of Lüke and Grosche (2017), who found that male teachers held more positive attitudes toward inclusion, and De Kraker-Pauw, van Wesel, Verwijmeren, Denessen, and Krabbandam (2016) who found that male teachers held stronger girls-guided learning and boys-independent learning associations than female teachers. Teachers' age was related to implicitly measured teacher attitude in three studies (Lau et al., 2018; Pit-ten Cate & Glock, 2018; Thomas, 2017), which was not significantly related to teachers' implicitly measured attitudes. Lau et al. (2018) examined the relation between teachers' BMI and their implicit anti-fat bias, which was measured with two different IATs, and both correlations were non-significant. Lüke and Grosche (2017) examined the effect of having children on teachers' attitudes toward inclusion and found that preservice teachers without children held more positive implicitly measured attitudes towards inclusion than their colleagues with children.

Twelve studies (24.5%) examined relations between implicitly measured teacher group associations and educational background characteristics of the teacher. Most of these educational background characteristics did not seem to be predictive of teachers' implicitly measured group associations. Two studies examined whether teachers differed from non-teachers in their implicitly measured attitudes and both indicated that there was no significant difference or a negligible difference between teachers and non-teachers concerning their implicitly measured group associations (Scanlon, McEnteggart, & Barnes-Holmes, 2020; Starck, Riddle, Sinclair, & Warikoo, 2020). Teaching experience was included in three studies (Fontana, Furtado, Marston, Mazzardo, & Gallagher, 2013; Markova et al., 2016; Pit-ten Cate & Glock, 2018; Wilson, Woolfson, & Durkin, 2019) and was not found to be a significant predictor of implicitly measured group associations. Likewise, the academic year or semester of preservice teachers were also not found to be predictive of their implicitly measured group associations (Fontana, Furtado, Marston, Mazzardo, & Gallagher, 2013; Lautenbach & Antoniewicz, 2018). In addition, three studies (Glock & Böhmer, 2018; Krishler & Pit-ten Cate, 2019; Scanlon, McEnteggart, & Barnes-Holmes, 2020) compared preservice and inservice teachers and both studies did not find significant differences between these two groups. Several other studies (Carmona-Márquez et al., 2020; Kelly & Barnes-Holmes, 2015; Lau et al., 2018; Wilson et al., 2019; Wüthrich & Sahli Lozano, 2018) examined whether a specialization of teachers was associated with their implicit attitudes. Wilson et al. (2019) and Wüthrich and Sahli Lozano (2018) found that teachers with a specialization in special education held more positive attitudes toward students with intellectual disabilities and towards inclusion, respectively. Teachers with a specialization in physical education exhibited a stronger

bias against overweight children on a motivated-lazy IAT, but not a good-bad IAT (Lau et al., 2018). Finally, De Kraker-Pauw et al. (2016) found that having a STEM background was associated with stronger gender-related beliefs regarding aptitude for science, but only for male teachers. Also, STEM teachers were found to hold stronger girls-guided learning and boys-independent learning associations than female teachers.

3.4.2. Teacher factors correlated with implicitly measured teacher attitudes

Almost half of the studies (23 studies; 46.9%) included one or multiple explicit measures and reported on the relations between the implicit and explicit measures of teacher group associations. Several other studies (e.g., Starck et al., 2020) included an explicit measure, but did not report on the relation between the implicit and explicit measure. The explicit measures differed in nature. Most of the explicit measures referred to an evaluative judgment of members of the group targeted in the implicit measure that closely resembled the implicit measure in terms of the type of attitude being measured and the specificity of the measures. For example, Fontana, Furtado, Mazzardo, Hong, and De Campos (2017) included an 'anti-fat attitude scale' as explicit measure and their implicit measure was aimed at participants' implicit anti-fat bias. Other studies included explicit measures that were more general in nature than the implicit measure. Several studies by Glock and colleagues, for example, included multiple explicit measures, ranging from *prejudiced beliefs* toward the target group, which closely matches the implicit measures of these studies, but also included *multicultural beliefs* referring to the willingness of teachers to adapt their teaching to cultural diversity in the classrooms and *enthusiasm* for teaching minority students, which were both less closely related to the implicitly assessed attitudes (Glock & Böhmer, 2018; Glock, Kovacs, & Pit-ten Cate, 2019; Glock & Kleen, 2019; Kleen & Glock, 2018). Lynagh, Cliff, and Morgan (2015) included teachers' expectations for overweight children among the explicit measures included in their study.

With regard to the relations between the implicit and explicit measures, the studies yielded diverging results. Ten studies (43.5% of the studies reporting on relations between implicit and explicit measures) found non-significant associations between implicit and explicit measures (Conaway & Bethune, 2015; Glock, Oude Groote Beverborg, & Müller, 2016; Harrison & Lakin, 2018a; Hornstra et al., 2010; Kumar et al., 2015; Markova et al., 2016; Nürnberger et al., 2016; Pit-ten Cate & Glock, 2018; Van den Bergh et al., 2010; Vezzali et al., 2012; Wilson et al., 2019; Wüthrich & Sahli Lozano, 2018). Eight studies (34.8%) (Fontana et al., 2017; Glock & Böhmer, 2018; Glock et al., 2019; Glock & Kleen, 2019; Harrison & Lakin, 2018b; Kelly & Barnes-Holmes, 2013, 2015; Lynagh et al., 2015) found mixed results, yet most of these studies included multiple explicit measures and found that most relations between implicit and explicit measures were non-significant. One study (Lautenbach & Antoniewicz, 2018) found negative correlations between teachers' implicitly measured attitudes towards inclusion and three different explicit measures (readiness to teach inclusively, promoting academic competencies, social inclusion), while one study (Axt, 2017) found a statistically significant positive relation between implicit and explicit group associations. Axt (2017) found that more positive implicitly measured attitudes toward Black students were weakly correlated with a single-item scale measure of preferences for Black relative to White people.

Glock et al. (2016) and Markova and colleagues (2015) also included a measure of motivation to act without prejudice. Markova and colleagues (2015) considered motivation to act without prejudice as an explicit measure of teachers' group associations, while Glock et al. (2016) considered these as two different measures and analyzed the predictive value of both an explicit measure of attitudes and the motivation to act without prejudice. Both studies reported on the relation between motivation to act without prejudice and participants' implicitly measured attitudes. Findings indicated that motivation to respond without prejudice was not related to implicitly measured attitudes.

3.4.3. Teacher factors predicted by implicitly measured teacher attitudes

Five studies (10.2%) included self-efficacy as a factor which may be predicted by participants' implicitly measured group associations (Glock & Böhmer, 2018; Glock et al., 2019; Glock & Klapproth, 2017; Glock & Kleen, 2019; Wilson et al., 2019). Most self-efficacy measures referred specifically to teachers' self-efficacy for teaching the target group, while one study (Glock & Kleen, 2019) also included a measure for more general teaching self-efficacy. They found that teachers' implicitly measured attitudes were not predictive of general teaching self-efficacy. The results for specific self-efficacy were mixed. Glock and Böhmer (2018) included two IATs, and found that only a personalized IAT of attitudes toward minority students (I like-I dislike), but not a non-personalized IAT (good-bad working habits) was predictive of teachers' self-efficacy. More positive implicit stereotypes of minority students were positively associated with more self-efficacy for working with minority students. The article by Glock and Kleen (2019) consisted of two studies. The first study was performed with preservice teachers and positive implicit attitudes were associated with stronger efficacy beliefs. The second study was performed with inservice teachers and the same implicit measure was not significantly associated with teachers' self-efficacy. Three studies (Glock et al., 2019; Glock & Klapproth, 2017; Wilson et al., 2019) did not find significant relations between implicit measures and specific self-efficacy for teaching target group students.

Three studies (6.1%) included measures of self-reported teaching practices or a behavioral outcome (Kumar et al., 2015; Lautenbach & Antoniewicz, 2018; Wilson et al., 2019). Kumar et al. (2015) included five measures, including promotion of respect in the classroom, responsibility for resolving interethnic conflict among students, responsibility for providing a culturally responsive curriculum, mastery approach to instruction mastery, and performance approach to instruction. Implicitly measured negative attitudes toward ethnic minority students were associated with lower scores on promotion of respect in the classroom, but were not related to the four other measures of self-reported teaching practices. Likewise, the other two studies also did not find significant relations between implicitly measured teacher attitudes and reported readiness or the intention to teach inclusively (Lautenbach & Antoniewicz, 2018; Wilson et al., 2019).

Reducing implicit bias. Two studies (40.8%) (Hein, Grumm, & Finngerle, 2011; Markova et al., 2016) reported on possibilities to reduce implicit bias of teachers. They included contact as a teacher-related factor, which is derived from the contact hypothesis (Allport, 1954) that states that high-quality contact with members of an outgroup can promote more positive out-group attitudes. Hein et al. (2011) examined whether the amount of contact and the quality of contact predicted teachers' implicit attitudes toward disabled people and Markova et al. (2016) asked participants about the number of family members or close friends with special education needs. Both studies, however, did not find a significant relation between contact and implicitly measured teacher attitudes.

Another way to examine the relation between contact and teachers' implicitly measured attitudes is to focus on the composition of the school, as the presence of a large proportion of students from the target group implies that the teacher has more contact and is more familiar with target group students. Hence, three studies (7.3%) examined school composition as a factor that may be associated with teachers' implicitly measured attitudes towards students with an ethnic minority background. These studies yielded mixed results. Kumar et al. (2015) found no relation between the ethnic composition of the school teachers were working at and their implicitly measured attitude towards ethnic minority students, while Glock and colleagues (2018) found both negative and positive effects of school composition on implicitly measured attitude towards ethnic minority students. Their study consisted of two studies, an experimental and a field study. In the experimental study, the authors found that preservice teachers in a high-diversity condition, which was operationalized through a vignette describing a highly diverse school, held more negative implicitly measured attitudes than

preservice teachers in a low-diversity condition. In contrast, in the field study, the actual proportion of minority students in the school of inservice teachers was found to be positively related to implicitly measured attitudes toward ethnic minority students. In addition, Peterson et al. (2016) found that teacher attitudes were more in favor of European students versus minority students when the average SES of the school was higher. Given that SES and ethnicity are often confounded (Cheng & Goodman, 2015), a higher school SES could imply a lower proportion of minority students, although the ethnic classroom composition was not included as a variable in this study. Another category of teacher-related factors, concerning teachers' work context, referred to the type of school teachers were working at, i.e. elementary or secondary school. This was examined in three studies (7.3%). No systematic differences were found between teachers working in elementary or secondary schools (Fontana et al., 2013; Glock & Klapproth, 2017; Pit-ten Cate & Glock, 2018).

Three studies (6.1%) described an intervention to reduce negative implicit group associations among teachers. Russell-Mayhew et al. (2015) examined the effects of an interactive professional development workshop. A comparison of pretest-posttest scores revealed a reduction in preservice teachers' implicit anti-fat bias. Scanlon and Barnes-Holmes (2013) examined the effects of a behavioral intervention (BI) and a stress-management intervention (SMI). Their whole sample received both interventions and did an IAT before, in between, and after the interventions. Their findings appeared to suggest that both interventions, especially the SMI, were effective in enhancing inservice teachers' implicit positivity toward pupils with emotional or behavioral disorders. However, results of statistical tests were not reported and the interventions did not have an effect on pre-service teachers' implicitly measured attitudes. Only the study by Whitford and Emerson (2019) used a randomized pretest-posttest control group design to examine the effect of an intervention. Their findings indicated that a brief empathy-inducing intervention, by means of reading about and reflection on the personal experiences of explicit racism faced by Black student peers, reduced preservice teachers' implicit racial bias.

3.5. Associations between student-related outcomes and implicitly measured teacher group associations

Relations between implicitly measured teacher group associations and teaching and student outcomes were examined in 17 studies (34.7%). Table 2 displays the key characteristics of the studies. One distinct feature of the studies was whether the study included hypothetical students or real students. Nine studies tested outcomes with regard to hypothetical students. The researchers designed descriptions of students or student work, called vignettes or case reports. Two studies used pictures of students who were not familiar to the participants. Participants in these studies were preservice teachers or students/professionals in the field of education (Axt, 2017; Bonefeld & Dickhäuser, 2018; Glock et al., 2016; Glock & Kleen, 2017; Halberstadt et al., 2020; Nürnberger et al., 2016). In two studies, both inservice teachers and preservice teachers participated (Glock & Böhmer, 2018; Krischler & Pit-ten Cate, 2019) and in one study only inservice teachers participated (Quinn, 2020). The other eight studies were field studies in which inservice teachers participated and outcomes of their own students (real students) were examined (Carmona-Márquez et al., 2020; Hornstra et al., 2010; Peterson et al., 2016; Readdy & Wallhead, 2016; Thijs et al., 2018; Thomas, 2017; Van den Bergh et al., 2010; Vezzali et al., 2012).

Nine of the 17 studies in which student-related outcomes were studied focused on student ethnicity (Axt, 2017; Bonefeld & Dickhäuser, 2018; Glock & Böhmer, 2018; Halberstadt et al., 2020; Peterson et al., 2016; Quinn, 2020; Thijs et al., 2018; Van den Bergh et al., 2010; Vezzali et al., 2012). Three focused on student gender (Glock & Kleen, 2017; Nürnberger et al., 2016; Thomas, 2017), three focused on physical appearance (Carmona-Márquez et al., 2020; Glock et al., 2016; Readdy & Wallhead, 2016) and two focused on special educational needs

Table 2

Relations between implicitly measured teacher attitudes and teaching and student outcomes.

First author	Year	Number of students	Outcomes	Association Implicit Measure	Association Explicit Measure	Description of significant results
<i>Hypothetical students</i>						
Axt	2017		Acceptance or rejection for an academic honor society	Sig	Sig	Explicit attitudes and implicit attitudes contributed uniquely to the prediction of race differences in criterion bias. Stronger explicit and implicit preferences for Whites were associated with a smaller pro-Black criterion bias.
Bonefeld	2018		Number of counted errors in dictation and grade for dictation	Mixed	–	A positive implicit attitude toward individuals with a migrant background led to lower grading of dictations written by a student with a migrant background than a negative attitude toward individuals without a migrant background.
Glock	2016		Judgement of students' language proficiency, mathematical skills, intelligence, engagement and social isolation.	Mixed	Mixed	Implicit and explicit attitude measures toward obesity were related to judgements of the language proficiency of obese students. Intelligence judgments were only predicted by explicit attitudes.
Glock	2017		Responses to student misbehavior	Mixed	–	The application of harsh interventions to the male student was positively related to participants' implicit associations. Implicit associations showed no relations when the participants worked on the female student description
Glock	2018		Choice for one of two students with regard to motivation for the subject, concentration, need for additional support and effort in school.	Mixed	Mixed	More negative implicit attitudes and higher explicit prejudiced beliefs were related to the perception of ethnic minority students' ability to concentrate. More negative implicit attitudes were related to the perceived ability to inspire ethnic minority students to like the subject.
Halberstadt	2020		Perceptions of children's emotions in facial expressions	Sig	Sig	Racialized anger bias was influenced by both implicit and explicit bias. High racially biased teachers were more likely to misattribute anger to Black than White children.
Krischler	2019		Judgments of students' language, mathematical performance, warmth and competence	Not sig	–	
Nürnbergger	2015		Judgment of students' interests and giftedness in math/science and language and student fit to a math/science- or a language-oriented school	Sig	Not sig	Implicit stereotypes uniquely contributed to the predicted variation of the overall judgements of students and to the predicted variation of the stereotypicality of school career recommendations.
Quinn	2020		Overall and specific ratings of writing task (vignette)	Not sig	Not sig	On a vague grade-level evaluation scale, teachers rated a student writing sample lower when it was randomly signaled to have a Black author, versus a White author. There was no evidence of racial bias when teachers used a rubric with more clearly defined evaluation criteria.
<i>Participants' own students</i>						
Carmona-Marquez	2020	1792	Level of physical activity (PA) of students	Mixed	Not sig.	There were no effects of teacher attitudes and stereotypes on the amount of PA of active students. There was an association between physical education (PE) teachers' stereotypes and whether or not the students engaged in PA, but not with the amount of exercise. The probability of students being inactive was found to be higher when PE teachers had strong implicit anti-fat stereotypes.
Hornstra	2010	307	Teachers' expectations of students' academic ability, grade for writing assignment and national standard spelling and math tests	Mixed	Not sig	When the teacher held a more negative attitude toward dyslexia, the achievement gap between students with and without dyslexia with regard to the writing achievement ratings and the spelling test scores increased.
Peterson	2016	1060	Teachers' expectations of students' academic ability and national standard math and reading tests	Mixed	–	When teachers' implicit stereotyped attitudes favored the student's ethnicity, these students performed better in mathematics at end-of-year.
Readdy	2016	Classes of 20–25 students that rotated	Teacher feedback	Mixed	Sig	Preservice teachers with stronger implicit and explicit anti-fat bias provided a higher frequency of general feedback to all students, irrespective of student weight status. Preservice teachers with moderate <i>explicit</i> anti-fat bias had a lower number of feedback interactions with overweight students and this feedback was more general. Preservice teachers with low implicit and explicit bias provided equitable feedback frequency and quality to students across the different weight categories.
Thijs	2018	707	Students' self-esteem and national identification	Mixed	–	

(continued on next page)

Table 2 (continued)

First author	Year	Number of students	Outcomes	Association Implicit Measure	Association Explicit Measure	Description of significant results
Thomas	2017	1647	Students' self-concept, intrinsic value and utility value related to science	Sig	–	More negative implicit attitudes of non-Muslim teachers were related to students' national identification, but not to students' self-esteem. Teachers' implicit 'science-is-male stereotypes' predicted higher self-concept and higher intrinsic value for male students and more negative deviation of females' self-concept and intrinsic value from that of their male classmates. The stronger teachers' 'implicit science-is-male stereotypes', the more females' utility value deviated negatively from that of their male classmates.
Vezzali	2012	30	Students' implicit prejudice towards immigrants	Sig	Not sig	Students' implicit prejudice towards immigrants was positively related to the implicit prejudice towards immigrants of their favorite teacher.
Van den Bergh	2010	307	Teachers' expectations of students' academic ability and national standard math and text comprehension tests	Sig	Not sig	When the teacher held a more negative attitude toward Turkish and Moroccan students, the gap between Turkish or Moroccan students and Dutch students with regard to expectations of the academic abilities, the math and text comprehension test scores increased.

(learning and/or behavior) (Hornstra et al., 2010; Krischler & Pit-ten Cate, 2019).

The studies used different - but all correlational - statistical analyses to relate implicit measures of teacher attitudes with student outcomes: simple or multiple regression analyses and hierarchical regression analyses. In one study on hypothetical students and in six of the nine studies on teachers' own students, multilevel analyses were conducted.

Four studies using hypothetical students focused on participants' perceptions of student characteristics and performance (Glock et al., 2016; Halberstadt et al., 2020; Krischler & Pit-ten Cate, 2019; Nürnberger et al., 2016). Results were mixed; in one study no significant results were found (Krishler & Pit-ten Cate, 2019). Glock et al. (2016) found mixed results. They used an implicit and explicit attitude measure. Dutch preservice teachers were given two case reports describing a male No. 1 in class student who was either of normal weight or obese. Judgements on five domains were asked, using a 7-point Likert scale. Judgements of the language proficiency of obese students was related to both measures. Intelligence judgments were only predicted by explicit attitudes. The other three outcomes were not predicted by the attitude measures. The third study (Nürnberger et al., 2016) found significant relations of the implicit measure with the overall judgements of students (the explicit measure was not related to these judgements). Finally, Halberstadt and colleagues found that both implicit and explicit bias influenced racialized anger bias. High racially biased teachers were more likely to misattribute anger to Black than White children.

Four studies using hypothetical students focused on participants' decisions regarding students (Axt, 2017; Glock & Böhmer, 2018; Glock & Kleen, 2017; Nürnberger et al., 2016). For example, Axt (2017) used applications of male applicants for an academic honor society containing a picture of the student's face, grade point averages in science and humanities, recommendation letters and an interview score. This information was varied with regard to skin color and qualifications. Educational professionals, recruited from a blog post on an educational website, viewed 60 applicants for a high school honor society. Then, they were asked to select or reject each applicant, with the instruction to accept half of the applicants. Educational professionals showed a pro-Black bias in judgement, adopting a lower acceptance criterion for Black compared to White applicants.

Both explicit and implicit attitude measures contributed uniquely to the prediction of race differences in this criterion bias. The other three studies found mixed results. Nürnberger et al. (2016) found significant relations of the implicit measure with the stereotypicality of school career recommendations, which were not related to with the explicit

measure. Glock and Böhmer (2018) found mixed results using a forced choice task. Implicit and explicit attitudes were related to participants' perception of ethnic minority students' ability to concentrate. Only implicit attitudes were related to the perceived ability to inspire ethnic minority students to like the subject. Other outcomes could not be predicted by the implicit nor the explicit measure of attitudes. Glock and Kleen (2017) found positive relations of implicit associations with the responses to a male student's misbehavior, but no relations when the participants worked on the female student description.

The last two studies that used hypothetical students focused on student achievement (Bonefeld & Dickhäuser, 2018; Quinn, 2020). Bonefeld and Dickhäuser (2018) used dictations of hypothetical 3rd grade students varied with regard to ethnicity and number of mistakes. Preservice teachers were shown a dictation and a brief description of the student who had allegedly written the dictation (a Turkish or German name and age). The participants were asked to rate the student's performance by giving the dictation a grade and by counting the number of errors. Results showed that positive implicit attitudes toward individuals with a migrant background led to worse grading of the dictations from migrant students. These findings were contrary to the expectations of the researchers. No explicit measure of attitudes was used in this study. Quinn (2020) found in a similar study that teachers rated a student writing sample lower when it was randomly signaled to have a Black author, versus a White author, when an overall evaluation scale was used. There was no evidence of racial bias when teachers used a rubric with more clearly defined evaluation criteria.

Of the studies in which outcomes of real students were examined, only one study included observations and focused on the quality and frequency of teacher feedback provided within K–12 physical education settings (Readdy & Wallhead, 2020). After completing an implicit and explicit attitude measure, the frequency and type of feedback provided to students perceived as normal and overweight was observed. Results showed that teachers with strong implicit and explicit bias and teachers who were not biased gave the same amount of feedback to all students. Teachers with moderate bias generally interacted less frequently with students perceived to be overweight. Overall, the authors state that teacher behavior is primarily guided by teachers' motivation to engage in good pedagogy and improve the skills of all learners.

Three studies focused on relations between teachers' implicit stereotyped attitudes with students' beliefs and attitudes (Thijs et al., 2018; Thomas, 2017; Vezzali et al., 2012). Thomas (2017) included the largest sample of students of all studies included in this review. Data were collected from 1647 students and their 88 teachers. The purpose of the

study was to examine associations of teachers' implicit 'science-is-male stereotypes' with male and female students' motivational beliefs in physical science classes. Results showed that teachers' implicit science-is-male stereotypes were positively related with male students' self-concept and intrinsic value and negatively associated with females' motivational beliefs. The other two studies also showed significant relations between teachers' implicit attitudes and students' national identification, but not with students' self-esteem (Thijs et al., 2018) and students' implicit prejudice towards immigrants (Vezzali et al., 2012).

One study focused on the relation between teachers' implicit attitudes and stereotypes toward obese people with the level of physical activity of their students (Carmona-Márquez et al., 2020). After comparing attitudes and stereotypes of physical education (PE) teachers with those of math teachers, the relations between anti-fat bias of the PE teachers was related to students self-reported level of physical activity using multilevel analysis. An association between PE teachers' stereotypes and whether or not the students engaged in PA was visible, but not with the amount of exercise taken. The probability of students being inactive was found to be higher when PE teachers had strong implicit anti-fat stereotypes.

Three studies examined relations between teachers' implicitly measured attitudes, teachers' expectations of individual students and students' academic achievement (Hornstra et al., 2010; Peterson et al., 2016; Van den Bergh et al., 2010). Van den Bergh et al. (2010) asked teachers to fill in a six-item scale regarding the teacher's expectations for the first ten students of the alphabetical list of student names in the classroom. Furthermore, these students' most recent standardized test scores for text comprehension and mathematics were requested. Differences in the sizes of the ethnic achievement gaps across classrooms were examined in relation to the stereotyped attitudes of the teachers. Results showed that the gap between Turkish or Moroccan students and Dutch students with regard to expectations of their academic abilities, math and text comprehension test scores was related to teachers' implicitly measured attitudes. The same procedure was followed by Hornstra et al. (2010). Implicit attitudes toward dyslexia were related with the achievement gap between students with and without dyslexia with regard to the writing achievement ratings and the spelling test scores, but not to teachers' expectations of academic abilities and math. Peterson and colleagues compared teachers' attitudes towards three ethnic groups of students in New Zealand. Results showed that when teachers' implicit prejudiced attitudes favored the student's ethnicity, these students performed better in mathematics measured with standardized tests.

In all studies in which teachers' own students were involved, significant relations between the implicit measure and student outcomes were found. Five of these studies also used an explicit measure of teachers' attitudes (Carmona-Márquez et al., 2020; Hornstra et al., 2010; Readdy & Wallhead, 2016; Van den Bergh et al., 2010; Vezzali et al., 2012). Explicit measures of teachers' group associations were not related to any of the outcomes in four of these studies. Readdy and Wallhead (2016) did find significant relations between preservice teachers' explicit anti-fat bias and the feedback they provided to their students.

4. Discussion

In this paper, a review is presented of 49 empirical studies in which implicit measures of teacher associations towards students have been used. Based on dual process theories (Fazio, 1990; Gawronski & Creighton, 2013) and theories on implicit social cognition (Greenwald & Banaji, 1995; Noseket al., 2012), we theorized that implicit measures of teachers' stereotypes and attitudes may sometimes predict behavior better than explicit measures, such as self-reports and questionnaires. With implicit measures, problems related to self-presentation and social desirability are less present and associations that someone may be unaware of (or of its consequence on behavior), can be measured

(Gawronski & De Houwer, 2014; Greenwald & Lai, 2020). This review included a large variety of implicit measures of teacher's group associations that have been developed between 2010 and 2020.

The studies included in this review showed that researchers have been very creative in the design of a variation of implicit measures of teacher attitudes. Many variations of implicit association tests and priming measures have been developed with names, pictures, associated words, and labels referring to various social groups and evaluations. Most frequently, IAT-measures of positive/negative evaluations with regards to ethnic groups have been used, but the variation in measures, targeted social groups, and evaluations was large. Still, there are many possible social groups for which implicit measures could be developed, depending on the social and educational context and the composition of school populations (e.g., specific cultural-ethnic minorities, cognitive and non-cognitive student characteristics, various types of special education needs). Besides positive and negative attitudes in general, several education-related evaluations have been measured, such as the performance related associations in Peterson et al.'s (2017) study and school-behavior evaluations in Kelly and Barnes-Holmes's study (2015). These education-related associations may be more relevant for studying specific differential treatments by teachers. Future research may further address the difference in predictive value of general and education-related evaluations of social categories. This is especially important given the ongoing debate with regards to the predictive validity of implicit measures (Bosson et al., 2000; Gawronski, 2019).

In this review, a large variation of measures has been observed in a relatively small body of empirical research. Most researchers used an implicit measure with stimuli specifically selected for their research question and there is limited attention for replication or validation of research outcomes using existing measures. Mixed results of study outcomes may be attributed to varying levels of psychometric quality across studies, such as test-retest correlations and the extent to which the implicit measure reflects bias, or conceptual correspondence between measurements (see also Gawronski, 2019). We suggest to conduct more research that is aimed at the validation of research findings with implicit measures of teachers' group associations.

Many studies examined whether background characteristics of teachers were predictive of implicitly measured teacher attitudes. The findings of this review suggest that teachers' associations do not systematically vary by teachers' demographic or educational background or by work context factors, with two exceptions. First, teachers were found to have more positive attitudes toward stigmatized groups when they, themselves, were a member of the stigmatized group. This finding is consistent with Social Identity Theory (SIT; Tajfel, 1981; Tajfel & Turner, 1986), which posits that the group to which people belong is important for their self-esteem. Therefore, people tend to be biased in favor of their ingroup (ingroup favoritism). Given the very common ethnic incongruence regarding teachers' and students' racial or ethnic background (e.g., Thijs, Westhof, & Koomen, 2012), this implicit ingroup bias of teachers is likely to have adversary effects on teachers' judgements of minority students and these students' academic outcomes. Second, the findings suggest that teachers who are specialized to work with a specific target group held more positive implicitly measured attitudes towards that target group. As only few studies examined the role of specialization, additional studies are needed to provide further support for this relation. Moreover, further research is needed to unravel whether teachers' attitudes became more positive due to their specialization, which likely includes more knowledge on and experience with the target group, or conversely, whether teachers with a more positive attitude towards those target groups were more likely to choose a specialization directed at that group.

Only few studies focused on relations between implicitly measured attitudes and teaching practices or student outcomes. Notably though, those studies which included student outcomes, provided clear support for the predictive value of implicit measures. Several studies found that implicitly measured teacher attitudes were predictive of actual student

outcomes (Hornstra et al., 2010; Peterson et al., 2016; Thijs et al., 2018; Thomas, 2017; Van den Bergh et al., 2010; Vezzali et al., 2012). In comparison, in these studies, explicit measures were not found to be predictive of these student outcomes. Hence, this review shows evidence for the presumed relation between implicitly measured teacher attitudes and student outcomes, but there is still a gap in the literature when it comes to the actual teaching practices explaining this relation. In order to further establish the effects of implicit measures of teacher attitudes, stronger research designs are needed which include observations of differential teaching practices or student perceptions of differential teacher behavior. In addition, as almost all studies in this review are cross-sectional and correlational, longitudinal designs are needed in order to gain more insights into the causality of relations between implicitly measured attitudes and teacher-related factors and student outcomes.

Striking differences between experimental studies and field studies were found. Experimental studies in which implicitly measured associations were related to outcomes of hypothetical students yielded mixed results, with non-significant findings as well as results in expected but also unexpected directions. In contrast to studies with hypothetical students, studies in which relations between teachers' implicitly measured attitudes and outcomes of their own students were examined, consistently found significant relations in the expected direction. Also, with regard to teacher-related factors, contradictory results were found between experimental and field studies. Whereas in field studies, negative implicitly measured teacher attitudes were found to be predictive of negative outcomes for students from stigmatized groups, studies with hypothetical students showed contradictory outcomes (e.g., Glock et al., 2018). This might indicate that the results and implications of experimental studies may not be easily transferred to real educational settings. In a recent study, Copur-Gencturk, Cimpian, Lubienski, and Thacker (2019) stated that by using fictitious students who are given stereotypical names, they had "overcome limitations of existing studies that ignore the broader and varied knowledge that teachers may have of the actual students in their classrooms" (p. 33). However, controlling for the complexity of actual classrooms comes at the expense of ecological validity. Based on the findings of this review, we doubt whether controlling for actual classroom factors by using hypothetical students is the most optimal solution for identifying the effects of teacher attitudes on student outcomes.

Implications. This review showed that implicit measures of teacher attitudes and stereotypes are relevant factors in the understanding of teacher behaviour and student outcomes in the context of equality of educational opportunities for all students. Although the usefulness of implicit measures has been disputed in some social psychology literature (Oswald et al., 2013; but see; Greenwald, Banaji, & Nosek, 2015; Kurdi et al., 2019), there is convincing evidence for the predictive value of implicit measures in social and political psychology (Jost, 2019). In this review, we cannot fully exclude the possibility of publication bias, which may have led to overreporting of significant results. However, the great number of non-significant findings, concerning both the teacher-related factors and student outcomes, suggests that publication bias only plays a modest role if at all. The findings of this review give preliminary support for usefulness of implicit measures in educational research as this review showed that in all eight studies in which relations between teachers' implicitly measured attitudes and outcomes of their own students were examined, significant relations were found, while explicit measure were not found to be related to any of the outcomes. So, even though the number of studies that used implicit measures of teachers' attitudes is still limited, few studies have focused on outcomes on teacher and student levels, and only one observation study has been conducted, results indicate that implicit measures have unique predictive value with regards to differential teaching and differential student outcomes. To understand how the effects of teachers' associations on student outcomes are established and what this means for students' academic, and motivational outcomes, future research, might focus on how these

associations are expressed in observable teacher-student interactions. Moreover, recent research suggested that interventions can contribute to change in implicitly measured associations over time (Greenwald & Lai, 2020). Hence, it could be possible that teacher interventions and education programmes may successfully reduce the negative effects of teachers' group associations and contribute to equal educational opportunities for all students.

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